

times as long as its base or kidney length, which is about as long as its diagonal base or 1.5 times pericardium. Ovotestis (G, f. 6) consisting of 4 lobes. Prostate shortly free from uterus (UT) at apical end. Free oviduct much shorter than vagina. Epiphallus with apical (papillate) sac ovoid. Penis (P) internally (opened ventrally and spread out in f. 7) with a slender verge, a pilaster (PP) and longitudinal folds in epiphallie branch (PE) and diverticulum; solid end of diverticulum with concave base. Base of penis and atrium with a large papillate thickening (YD) on dorsal side. Radular formula (f. 5): 13+1+2+11, 23 rows counted (Strebel found 35); second tooth large enough to cover most of 15 complete rows from radula of *S. perpusilla*; see Strebel (pl. 11, f. 8), who also shows 11 marginals; entire radula about 5 mm. long.

SURVIVAL OF FRESH WATER MOLLUSKS DURING PERIODS OF DRYNESS

BY WILLIAM MARCUS INGRAM

The observations included here were made during the period of from June 15 to September 1, 1940, on the Edmund Niles Huyck Preserve, Rensselaerville, Albany County, New York. During this time two species of fresh-water mollusks, one a clam, *Pisidium abditum* Haldeman, the other a snail, *Physa gyrina* Say, were observed living apparently with some success, although deprived of their customary watery habitat.

While collecting mollusks in Trout Pond Stream on the preserve, 21 individuals of *Physa gyrina* were found in the dry streambed which had been without running water for a period of from June 25 to August 13. The stream bottom was formed from compactly packed gravel and large rocks, which prevented these animals from burrowing to carry on aestivation. Thus individuals had the choice of remaining on top of the gravel covering the streambed, or of crawling beneath the rocks which rested on the gravel bottom. The latter location provided an environment with greater moisture than did the exposed situation, for the gravel beneath the rocks was moist.

Of the 21 individuals studied, 9 were beneath stones and 12 were in the open. The snails seemed able to survive unfavorable conditions about equally well in the exposed and concealed situations: 5 of the exposed *Physa* were found dead and 7 were taken

living; 4 of the concealed *Physa* were dead and 5 were living. The living and deceased mollusks in the exposed habitat were all taken from shaded areas of the streambed, where a boulder or maple trees on the bank provided overhang. The streambed was further shaded by the steepness of the surrounding cliffs, which shut out direct sunlight except for about 3 hours from 11 A.M. to 2 P.M. During the period of the stream's dryness there were several rain showers which served to moisten the gravel of its bed, but never did enough water fall to form pools of standing water into which the *Physa* could retreat. However, 90 feet from the area in which the snails were observed, there was a pool of standing water, but no snail moved more than 4 inches during the 49 days that they were away from water.

Animals found beneath rocks with the *Physa* were 2 crayfish, *Cambarus* sp.; 7 water beetles, *Dytiscus* sp.; and 1 water-strider, *Gerris* sp. All of these invertebrates survived the dry period concealed beneath rocks. The 2 *Cambarus* sp., both of which had tunneled into the moist gravel beneath a rock, were apparently the only ones capable of burrowing in the firmly packed gravel bottom.

That other invertebrates, *Physa* excluded, will leave unfavorable conditions, or follow retreating water to seek a stable pool during a drought, seemed to be evidenced by finding the following dense Arthropod aggregation in a standing pool of water not affected by the drought: 83 *Gerris*, 40 *Dytiscus*, and 7 *Eubbranchipus*. This pool was 7 feet long by 2 feet wide, with a 5 inch maximum depth.

During the summer of 1939 this stream was without running water for 60 days. The fact that the *Physa* observed were found approximately 300 yards upstream from the nearest permanent pool would probably indicate that in this locality this gastropod can successfully survive extended periods of exposure summer after summer. It does not seem likely that individuals in this stream can travel 300 yards against a current during a period of from 30 to 60 days when the Trout Pond Stream is flowing, an act which would have to take place yearly provided that the upstream population could not survive drought and by so doing maintain an upstream population through dry periods. On August 14 Trout Pond Stream was again with running water.

The 12 living *Physa* which had been observed over the period of June 25 to August 14th were again returned to ideal environmental conditions.

Thirteen *Pisidium abditum* Haldeman were collected beside Myosotis Lake, on the shore of loosely packed flat shale fragments, a habitat which was apparently not typical. This species is usually found, according to Baker (1898, 1918, 1928) and Goodrich (1939) in watery habitats varying from mud, sand, or clay, to aquatic plants and muck bottoms in lakes and streams. At the time these individuals were observed they were 10 feet away from the water's edge, and were 3 feet above the summer's high-water mark. Eleven of the 13 were found in the spring flood zone, beneath the débris consisting of small sticks and dead grass. The other two individuals were beneath large flat shale rocks in the débris zone. These 13 individuals were in such a habitat at least from June 15 to September 1. No standing rain water was ever observed in this area. Several rains during the summer served, however, to keep the *Pisidia* colony moist, thus possibly enhancing their chances of survival. The shore area was protected from the sun's rays for a part of the day by the overhang of beeches growing on the shore.

The absence of dead individuals of this species in the area under observation seems to indicate that this species under the stated conditions can successfully withstand exposure to air, lack of food, and lack of optimum moisture conditions for extended periods of time on the Myosotis Lake shore. Due to the rocky character of the shore none of the 13 individuals were capable of burrowing into the substratum. Baker (1928), referring to the Sphaeriidae in general, states, "Many of them live in ponds or pools that dry up for a large part of the year, being full of water only in the spring. In these places most of the animals die during the dry interval, a few surviving by burrowing deeply in the mud bottom."

When the observation colony was collected and placed in formaldehyde 6 young were voided into the preserving fluid. The embryos apparently develop within the parent throughout the spring and summer months and are released into the water during late September or in November when the lake level rises. If this does not occur the young would have to be released directly

on the shore or held in the parent through the winter to be released into the water during the following spring flood of May.

This data concerning the *Pisidia* colony is presented here with Baker's (1928) statement in mind, "There is much need for more accurate data on the ecology of these small clams [Sphaeriidae] as well as upon their age, reproduction, and general habits."

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DAYLIGHT ACTIVITY OF LAND MOLLUSKS

BY WILLIAM MARCUS INGRAM

The following observations were made between June 15 and September 1, 1940, on the Edmund Niles Huyek Preserve, Rensselaerville, Albany County, New York. The preserve is a tract of land of some 500 acres situated in the Helderberg Mountains, the altitude varying approximately from 1500 to 1750 feet. The climax forest is beech-hemlock.